

WHAT IS CLAIMED IS:

1. A lens aberration monitor for detecting lens aberrations, said monitor comprising:
a mask for transferring a lithographic pattern onto a substrate, and
a plurality of non-resolvable features disposed on said mask, said plurality of non-resolvable features arranged so as to form a predetermined pattern on said substrate, said predetermined pattern being utilized to detect lens aberrations.
2. The lens aberration monitor of claim 1, wherein each of said plurality of non-resolvable features has a square-shaped cross-sectional configuration, said plurality of non-resolvable features being positioned with respect to one another so as to form a circular-shape.
3. The lens aberration monitor of claim 2, wherein each of said plurality of non-resolvable features having said square-shaped cross-sectional configuration, exhibits a length of about $0.30 (\lambda/NA)$ or less per side, where λ equals the wavelength of a light source utilized to image said mask and NA equals the numerical aperture of an objective lens used to image the mask onto the substrate.
4. The lens aberration monitor of claim 2, wherein the spacing between adjacent edges of adjacent non-resolvable features is about $0.15 (\lambda/NA)$ or less per side, where λ equals the wavelength of a light source utilized to image said mask and NA equals the numerical aperture of an objective lens used to image the mask onto the substrate.
5. The lens aberration monitor of claim 2, wherein a first set of said plurality of non-resolvable features which are adjacent one another overlap in an X-direction, and a second set of said plurality of non-resolvable features overlap in a Y-direction, substantially orthogonal to said X-direction, said overlap in said X-direction being equal to said overlap in said Y-direction.

6. The lens aberration monitor of claim 1, wherein each of said plurality of non-resolvable features is a π -phase shifting element.

7. The lens aberration monitor of claim 1, wherein said predetermined pattern formed on said substrate is a ring-shaped pattern.

8. The lens aberration monitor of claim 1, wherein said mask further comprises a lithographic pattern corresponding to an integrated circuit to be formed on said substrate.

9. The lens aberration monitor of claim 1, wherein said mask is a 6% attenuated phase-shift mask.

10. The lens aberration monitor of claim 1, wherein said mask is a binary chrome mask.

11. A method of forming a lens aberration monitor for detecting lens aberrations, said method comprising the steps:

forming a mask for transferring a lithographic pattern onto a substrate, and

forming a plurality of non-resolvable features disposed on said mask, said plurality of non-resolvable features arranged so as to form a predetermined pattern on said substrate, said predetermined pattern being utilized to detect lens aberrations.

12. The method of forming the lens aberration monitor of claim 11, wherein each of said plurality of non-resolvable features has a square-shaped cross-sectional configuration, said plurality of non-resolvable features being positioned with respect to one another so as to form a circular-shape.

13. The method of forming the lens aberration monitor of claim 12, wherein each of said plurality of non-resolvable features having said square-shaped cross-sectional configuration, exhibits a length of about $0.30 (\lambda/\text{NA})$ or less per side, where λ equals the wavelength of a light

source utilized to image said mask and NA equals the numerical aperture of an objective lens used to image the mask onto the substrate.

14. The method of forming the lens aberration monitor of claim 12, wherein the spacing between adjacent edges of adjacent non-resolvable features is about $0.15 (\lambda/NA)$ or less per side, where λ equals the wavelength of a light source utilized to image said mask and NA equals the numerical aperture of an objective lens used to image the mask onto the substrate.

15. The method of forming the lens aberration monitor of claim 12, wherein a first set of said plurality of non-resolvable features which are adjacent one another overlap in an X-direction, and a second set of said plurality of non-resolvable features overlap in a Y-direction, substantially orthogonal to said X-direction, said overlap in said X-direction being equal to said overlap in said Y-direction.

16. The method of forming the lens aberration monitor of claim 11, wherein each of said plurality of non-resolvable features is a π -phase shifting element.

17. The method of forming the lens aberration monitor of claim 11, wherein said predetermined pattern formed on said substrate is a ring-shaped pattern.

18. The method of forming the lens aberration monitor of claim 11, wherein said mask further comprises a lithographic pattern corresponding to an integrated circuit to be formed on said substrate.

19. The method of forming the lens aberration monitor of claim 11, wherein said mask is a 6% attenuated phase-shift mask.

20. The method of forming the lens aberration monitor of claim 11, wherein said mask is a binary chrome mask.

21. A lens aberration monitor for detecting lens aberrations, said monitor comprising:

a mask for transferring a lithographic pattern onto a substrate,
a plurality of non-resolvable features disposed on said mask, said plurality of non-resolvable features arranged so as to form a predetermined pattern on said substrate, said predetermined pattern being utilized to detect lens aberrations, and
a lithographic pattern disposed on said mask, said lithographic corresponding to a device to be formed on said substrate.

22. A method of detecting aberrations associated with a projection lens utilized in an optical lithography system, said method comprising the steps:

forming a mask for transferring a lithographic pattern onto a substrate,
forming a plurality of non-resolvable features disposed on said mask, said plurality of non-resolvable features arranged so as to form a predetermined pattern on said substrate,
exposing said mask using an optical exposure tool so as to print said mask on said substrate, and
analyzing the position of said predetermined pattern formed on said substrate and the position of said plurality of non-resolvable features disposed on said mask so as to determine if there is an aberration.

23. The method of detecting aberrations associated with a projection lens utilized in an optical lithography system of claim 22, wherein each of said plurality of non-resolvable features has a square-shaped cross-sectional configuration, said plurality of non-resolvable features being positioned with respect to one another so as to form a circular-shape.

24. The method of detecting aberrations associated with a projection lens utilized in an optical lithography system of claim 23, wherein each of said plurality of non-resolvable

features having said square-shaped cross-sectional configuration, exhibits a length of about $0.30 (\lambda/NA)$ or less per side, where λ equals the wavelength of a light source utilized to image said mask and NA equals the numerical aperture of an objective lens used to image the mask onto the substrate.

25. The method of detecting aberrations associated with a projection lens utilized in an optical lithography system of claim 24, wherein the spacing between adjacent edges of adjacent non-resolvable features is about $0.15 (\lambda/NA)$ or less per side, where λ equals the wavelength of a light source utilized to image said mask and NA equals the numerical aperture of an objective lens used to image the mask onto the substrate.

26. The method of detecting aberrations associated with a projection lens utilized in an optical lithography system of claim 22, wherein said predetermined pattern formed on said substrate is a ring-shaped pattern.

27. The method of detecting aberrations associated with a projection lens utilized in an optical lithography system of claim 22, wherein said mask further comprises a lithographic pattern corresponding to a device to be formed on said substrate.

28. The method of detecting aberrations associated with a projection lens utilized in an optical lithography system of claim 22, wherein a first set of said plurality of non-resolvable features which are adjacent one another overlap in an X-direction, and a second set of said plurality of non-resolvable features overlap in a Y-direction, substantially orthogonal to said x-direction, said overlap in said X-direction being equal to said overlap in said Y-direction.

29. The method of detecting aberrations associated with a projection lens utilized in an optical lithography system of claim 22, wherein each of said plurality of non-resolvable features is a π -phase shifting element.

30. The method of detecting aberrations associated with a projection lens utilized in an optical lithography system of claim 22, wherein said mask is a 6% attenuated phase-shift mask.

31. The method of detecting aberrations associated with a projection lens utilized in an optical lithography system of claim 22, wherein said mask is a binary chrome mask.

32. A device manufacturing method comprising the steps of:

(a) providing a substrate which is at least partially covered by a layer of radiation-sensitive material;

(b) providing a mask which contains a pattern;

(c) using a projection beam of radiation and an objective lens to project an image of at least part of the mask pattern onto a target area of the layer of radiation-sensitive material, wherein prior to performing step (c), an aberration monitoring step is performed comprising the step of forming a plurality of non-resolvable features on said mask, said plurality of non-resolvable features arranged so as to form a predetermined pattern on said substrate, said predetermined pattern being utilized to detect lens aberrations.

33. The device manufacturing method of claim 32, wherein each of said plurality of non-resolvable features has a square-shaped cross-sectional configuration, said plurality of non-resolvable features being positioned with respect to one another so as to form a circular-shape.

34. The device manufacturing method of claim 33, wherein each of said plurality of non-resolvable features having said square-shaped cross-sectional configuration, exhibits a length of about $0.30 (\lambda/NA)$ or less per side, where λ equals the wavelength of a light source utilized to image said mask and NA equals the numerical aperture of the objective lens used to image the mask onto the substrate.

35. The device manufacturing method of claim 33, wherein the spacing between adjacent edges of adjacent non-resolvable features is about $0.15 (\lambda/NA)$ or less per side, where λ equals the wavelength of a light source utilized to image said mask and NA equals the numerical aperture of an objective lens used to image the mask onto the substrate.

36. The device manufacturing method of claim 33, wherein a first set of said plurality of non-resolvable features which are adjacent one another overlap in an X-direction, and a second set of said plurality of non-resolvable features overlap in a Y-direction, substantially orthogonal to said X-direction, said overlap in said X-direction being equal to said overlap in said Y-direction.

37. The device manufacturing method of claim 32, wherein each of said plurality of non-resolvable features is a π -phase shifting element.

38. The device manufacturing method of claim 32, wherein said predetermined pattern formed on said substrate is a ring-shaped pattern.

39. The device manufacturing method of claim 32, wherein said pattern corresponds to an integrated circuit to be formed on said substrate.

40. The device manufacturing method of claim 32, wherein said mask is a 6% attenuated phase-shift mask.

41. The device manufacturing method of claim 32, wherein said mask is a binary chrome mask.